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Weak magnetic field behavior of photon echo in a LuLiF4:Er 3+ crystal

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Abstract

We report the first observation and study of the photon echo in Er 3+:LuLiF4. The energy transition is 4 I 15/2 → 4 F 9/2 (λ = 6536 Å). The density of ErF3 is 0.025 wt %. The operation temperature is 1.9 K. Measurements were made at low (up to 1200 Oe) and even zero external magnetic fields. We studied the behavior of the photon echo intensity vs. the magnetic field magnitude and direction about the crystal axis C and vs. the laser pulse separation t 12 and observed an exponential growth and then, after a certain plateau, an exponential decrease in the photon echo intensity as a function of magnetic field upon increasing the magnetic field from zero. The parameters describing the exponential growth and decrease are independent of the direction of magnetic field. The value of the magnetic field (~20-200 Oe) at which the echo intensity is maximal and the value of the maximum itself decrease with increasing pulse separation t 12 and the angle Θ between the magnetic field and crystal axis. The echo intensity decreases exponentially with increasing Θ. The parameter describing the exponential decrease is independent of the magnitude of the field. The echo intensity as a function of pulse separation shows exponential decay. The phase relaxation time depends on the magnitude and direction of the magnetic field. T 2 is equal to 202 ± 16 ns at zero magnetic field. A phenomenological formula is suggested, which qualitatively presents the mentioned dependences, and the polarization properties of the backward photon echo in this crystal are studied. Because the ion of trivalent erbium is an optimum data carrier, the above results show that fine control of the multichannel transfer of processed optical information may be achieved by weak magnetic fields. © Nauka/Interperiodica 2007.

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